US ARMY CORPS
OF ENGINEERS
NEW ENGLAND DIVISION

INVENTORY INSPECTION AND RATING REPORT

BARRE FALLS DAM SERVICE BRIDGE
BARRE FALLS DAM
BARRE, MASSACHUSETTS

October 1995

COMMONWEALTH OF MASSACHUSETTS
KIN CHUNG
LAM
CIVIL
No. 32881
REGISTERED
PROFESSIONAL ENGINEER

NEW ENGLAND DIVISION

LAMSON ENGINEERING CORPORATION
1069 WASHINGTON STREET, NEWTON, MASSACHUSETTS 02156

EXECUTIVE SUMMARY

As directed in the Delivery Order No. 0001 of contract No. DACW 33-95-D-0006, an inventory inspection and rating were performed on Barre Falls Dam Service Bridge in Barre Massachusetts.

The bridge was constructed in 1958 and designed to support an H-12 truck loading.

The bridge is a simple span structure composed of a reinforced concrete deck on top of two (2) steel stringers. It is supported by a concrete gravity abutment at one end, and a gate house at the other. The length of the bridge from center to center of bearings is 48'-2½" and the width of the bridge (out to out) is 12'-0".

The inspection shows that the bridge is in generally good condition. The rating results indicate that the live load capacity of the bridge at inventory level is 26.2 tons for an HS20-44 truck and 16.1 tons for an H20-44 truck.

The statutory loading for the HS20-44 truck and the H20-44 truck is 36 tons and 20 tons, respectively. It is therefore recommended that the bridge be posted, and general maintenance and inspections be performed at regular intervals.

EXECUTIVE SUMMARY

TABLE OF CONTENTS

A. INTRODUCTION

Delivery Order No. 0001 of Contract No. DACW 33-95-D-0006 requires an inventory inspection and live load capacity rating for Barre Falls Dam Service Bridge in Barre Massachusetts. The service bridge is located over the upstream slope of the dam and provides access to the gate house. The location of the bridge is shown in ***Fig. 1 - Project Location Plan*** of this report.

B. BRIDGE DESCRIPTION AND HISTORY

Barre Falls Dam Service Bridge was constructed in 1958. It is a single span steel structure with a 10'-0" wide roadway and 48'-2 ½" long span. There is no skew angle for the bridge.

The superstructure is composed of reinforced concrete deck slab supported by two (2) 30" WF 116# steel stringers spaced at 7'-6" on center. The stringers are braced by four (4) 21" WF 62# diaphragms. There is steel pipe railing supported by 10" thick reinforced concrete curb along each side of the bridge.

The superstructure is supported by the south abutment at one end, and a concrete haunch built integrally with the gate house at the other end. The south abutment is a gravity type concrete wall, and the gate house is a reinforced concrete structure.

The plan and sections of the service bridge are shown in Figures 2 through 4 , and **Appendix D** of this report.

No prior rating has been performed on this bridge to date.

C. INSPECTION PROCEDURE

The inspection was primarily performed according to the guidelines listed in the *Bridge Inspectors Training Manual/90*, dated July 1991, published by the Federal Highway Administration, and the previous subtitled *Method of Performance of Physical Inspection*, by Lamson Engineering Corp., dated 7/1995.

The field inspection included a visual inspection of all components above ground. All pertinent data concerning condition findings of the various bridge elements were recorded on inspection forms in **Appendix B**. The inspection findings are presented in ***Section D - Inspection Results***, and ***Fig 5 - Summary of Inspection***, of this report. 35mm color photographs were taken and are included in **Appendix A**.

D. INSPECTION RESULTS

Approach Roadway

The south approach roadway for the bridge is constructed of bituminous concrete pavement which is in good condition. A post and cable guardrail is present on each side of the travel path and is little slackened.

Substructure

Abutment

The south abutment is a concrete gravity section in good condition (Photos 8 & 10).

Gate House (Exterior Only)

A concrete haunch built integrally with the gate house acts as the support for the north end of the bridge. The concrete exterior of the gate house and its concrete haunch are in good condition (Photos 7 & 9).

Superstructure

Steel

All stringers, diaphragms, and angles which constitute the framing plan of the superstructure are in good condition with no signs of corrosion or any section loss (Photo 6).

Bearings

Both expansion end and fixed end bearings are in good condition (Photo 8).

Deck/Curb

The concrete deck surface and curb are in good condition as well as the underside of the deck. Insect nests are present in a few areas on the underside of the deck (Photo 5).

Paint

The paint on all steel members of the bridge is in good condition (Photo 4).

Miscellaneous

Railing

The steel pipe railing on the bridge is in good condition.

Scuppers

The are four scuppers placed in pairs at the north and south ends of the bridge. All scuppers are in good working condition.

Utility

The utility support is in good and stable condition. There are no missing bolts or broken conduits. Insect nests are noted in the connection hole of the utility support (Photo 11).

DESCRIPTION OF BRIDGE

DATE OF CONSTRUCTION:	1958
ORIGINAL DESIGN LOADING	H-12
POSTED LIMITS:	None
BRIDGE TYPE:	Steel Stringers
SKEW:	0 Degree
SPAN:	1 Span @ 48'-2½ Center to Center of Bearing
WIDTH OF BRIDGE DECK:	12'-0" Out to Out.
ROADWAY WIDTH:	10'-0" Curb to Curb.
ROADWAY SURFACE:	Reinforced Concrete Deck.
BRIDGE RAILING:	3-Rail Steel Pipe Railing.
APPROACH RAILING:	Steel Cable.
SUPERSTRUCTURE:	Reinforced Concrete Slab on 2 - Steel Stringers.
MODIFICATION TO ORIGINAL SUPERSTRUCTURE:	None.
UTILITIES:	2 -2" Electric Conduits 2 - 3" Electric Conduits. 2 - 2" Telephone Conduits
SUBSTRUCTURE:	South End: Concrete Gravity Wall North End: Gate House
MODIFICATION TO ORIGINAL SUBSTRUCTURE:	None.
ALIGNMENT:	Both the horizontal alignment and the vertical profile of the bridge are on a tangent. Traveling vehicles require almost a complete stop to turn from the main road to the service bridge.

E. FRACTURE CRITICAL EVALUATION

A Fracture Critical Member (FCM) is a member in tension or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse. FCM's are subject to fracture due to brittle fracture or fatigue failure. Brittle fracture of steel member can be caused by the sudden application of a load which causes high total stresses in the presence of a defect in the metal (i.e. nick, notch, crack) and is more likely to occur during cold weather when the steel tends to be more brittle. The formation of a fatigue crack in a steel member is caused by repeated cycles of stress due to live loads. The fatigue life of a steel bridge is dependent on the magnitude of the stress range and the fatigue strength of details. The fracture critical members on this bridge consist of the girders. The girders appear to be in good condition. Further testing does not appear necessary at this time although special attention should be given to these members in subsequent scheduled inspections.

F. RATING ANALYSIS

F.1 Criteria and Assumptions

The live load capacity rating of the bridge was rated in accordance with the provisions of the *1983 Edition of the Manual for Maintenance Inspection of Bridges*, and the 1984 through 1990 *Interim Specifications* published by the American Association of State Highway and Transportation Officials (AASHTO).

AASHTO *Standard Specifications for Highway Bridges, 15 Edition, 1992*, and the 1993, 1994 *Interim Specifications* are also used in the rating analysis.

Based on a review of the COE's plan and Inspection results, no reductions in member capacities were assumed.

The following allowable unit stresses are used in the rating calculations:

Concrete

fc' = 2,500 psi
fc = 1,000 psi (Inventory)
fc = 1,500 psi (Operating)

Steel

fy = 33.0 ksi
fs = 18.0 ksi (Inventory)
fs = 24.5 ksi (Operating)

The bridge will be initially rated based on HS-20 truck loading. If the result of the rating based on HS-20 truck loading is less than 36 tons, the bridge will further be rated under the H-20 truck loading. The loading diagrams of these trucks are shown in **Fig. 6** of this report.

Based on the visual inspection, the abutment and the gate house are assumed to be in good condition. They are not considered critical in rating purposes.

F.2 Results of Rating Analysis

Based on the rating criteria and assumptions, rating calculations are performed and are included in **Appendix C**. Because of the geometry of the bridge (perpendicular to dam crest with tight access) impact was not considered. The rating results are as follows:

COMPONENTS	HS20-44 TRUCK		H20-44 TRUCK	
	INVENTORY (TON)	OPERATING (TON)	INVENTORY (TON)	OPERATING (TON)
CONCRETE SLAB	29.1	**38.9**	**16.1**	**21.7**
STEEL STRINGERS	**26.2**	46.3	20.3	35.8

G. EVALUATION

The evaluation of the bridge is based on the findings of the inspection, the results of the rating analysis, and the current AASHTO *Standard Specifications for Highway Bridges, 15 Edition, 1992*, and the 1993, 1994 *Interim Specifications*.

G.1 Safety Concern

The following Bridge components are found to be deficient by the current AASHTO standard:

(a) Railing
The existing 3-rail 2 ½" diameter steel pipe railing installed along both sides of the bridges are not believed to be crash-proof for an HS20-44 truck. (The railing is good for hand railing).

(b) Width
The existing width, curb to curb, of the bridge is 10'-0" which is considerably less than the standard lane width (12'-0") and shoulder width (2'-0") on each side of the curbs.

(c) Sidewalk / Safety Walk
Neither sidewalk nor safety walk is provided for this bridge.

An upgrade of the bridge railing to be crash-proof, an extension of the curb to curb width on the bridge deck, and an addition of either a sidewalk or a safetywalk on the bridge would require a major rehabilitation of the existing bridge.

Our inspection found that the consequences resulted by these deficiencies are alleviated by the following factors:

- The bridge is not open to the public.
- Access to the bridge is prohibited by a gate barrier.

- A 90-degree intersection to the dam access road requires a vehicle to come to almost a complete stop before turning onto the bridge.
- The tangent alignment of the bridge provides a good sight distance.

Therefore major rehabilitation to correct these deficiencies is not considered necessary.

G.2 Deck Drainage
There are four (4) scuppers on the bridge. They are in good working condition.

However, a large puddle of water was noted on the bridge deck (Photos 1 & 2) indicating that the deck was not graded properly to divert the water to the scuppers.

G.3 Rating Results
The statutory loading for HS20-44 and H20-44 trucks are 36 tons and 20 tons, respectively.

According to the available existing drawing, the bridge was designed for an H12 truck loading. The results of the computations indicate that the bridge is rated for 26.2 and 16.1 tons at inventory level for the respective HS20-44 and H20-44 type trucks.

Therefore, the bridge has a capacity larger than its original design load, but considerably less than the statutory loading.

A load posting sign is therefore required.

H. SUMMARY AND RECOMMENDATION

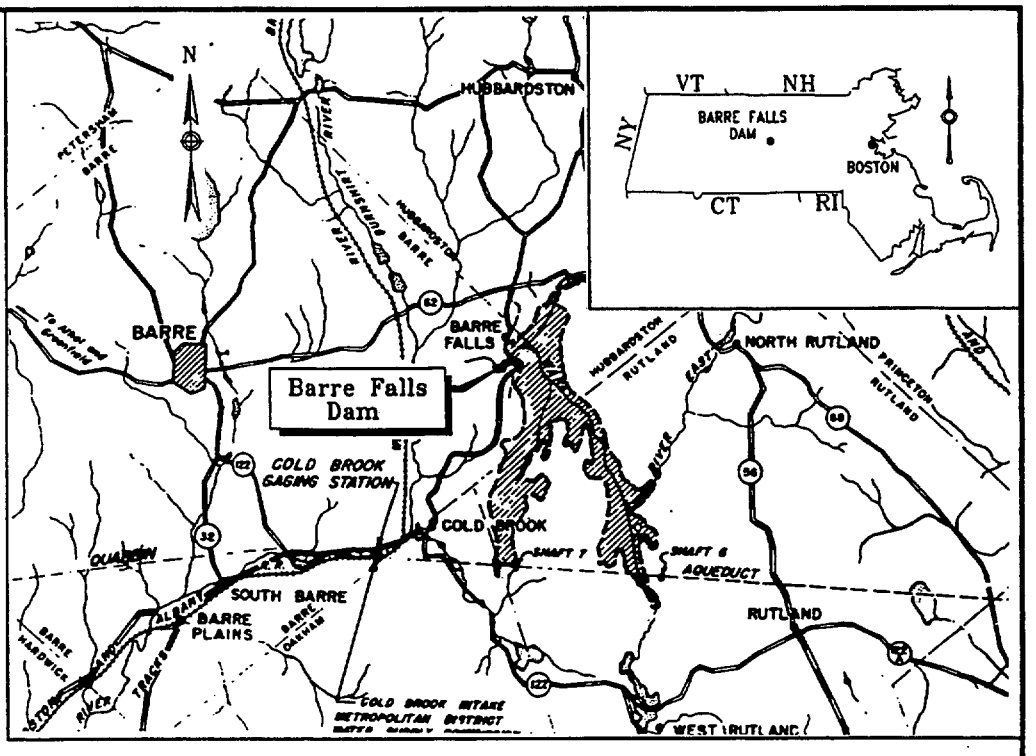
1. The inspection findings indicate that the bridge is generally in good condition. There are a few areas on the underside of the deck where insect nests are present.

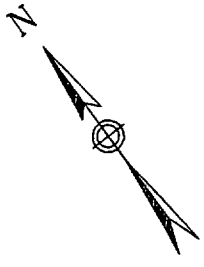
2. The bridge is rated for 26.2 and 16.1 tons at inventory level for HS20-44 and H20-44 trucks, respectively.

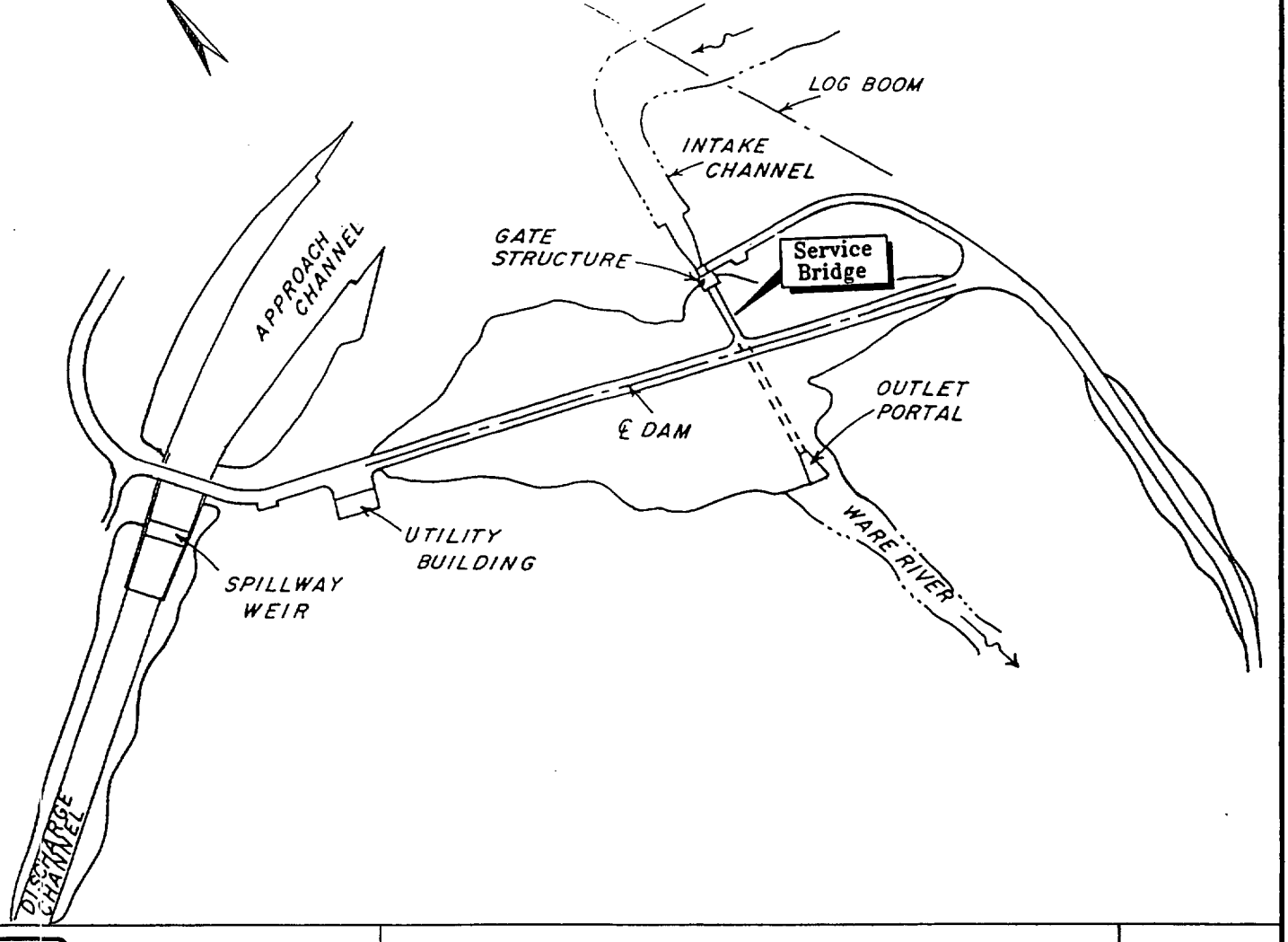
Recommendations

1. It is recommended that the bridge be posted at 26 tons and 16 tons for HS20-44 and H20-44 type trucks, respectively.

2. General maintenance and inspection be continued at regular intervals, incorporating the cleaning and removal of all insect nests on the underside of the deck.







US ARMY CORPS OF ENGINEERS
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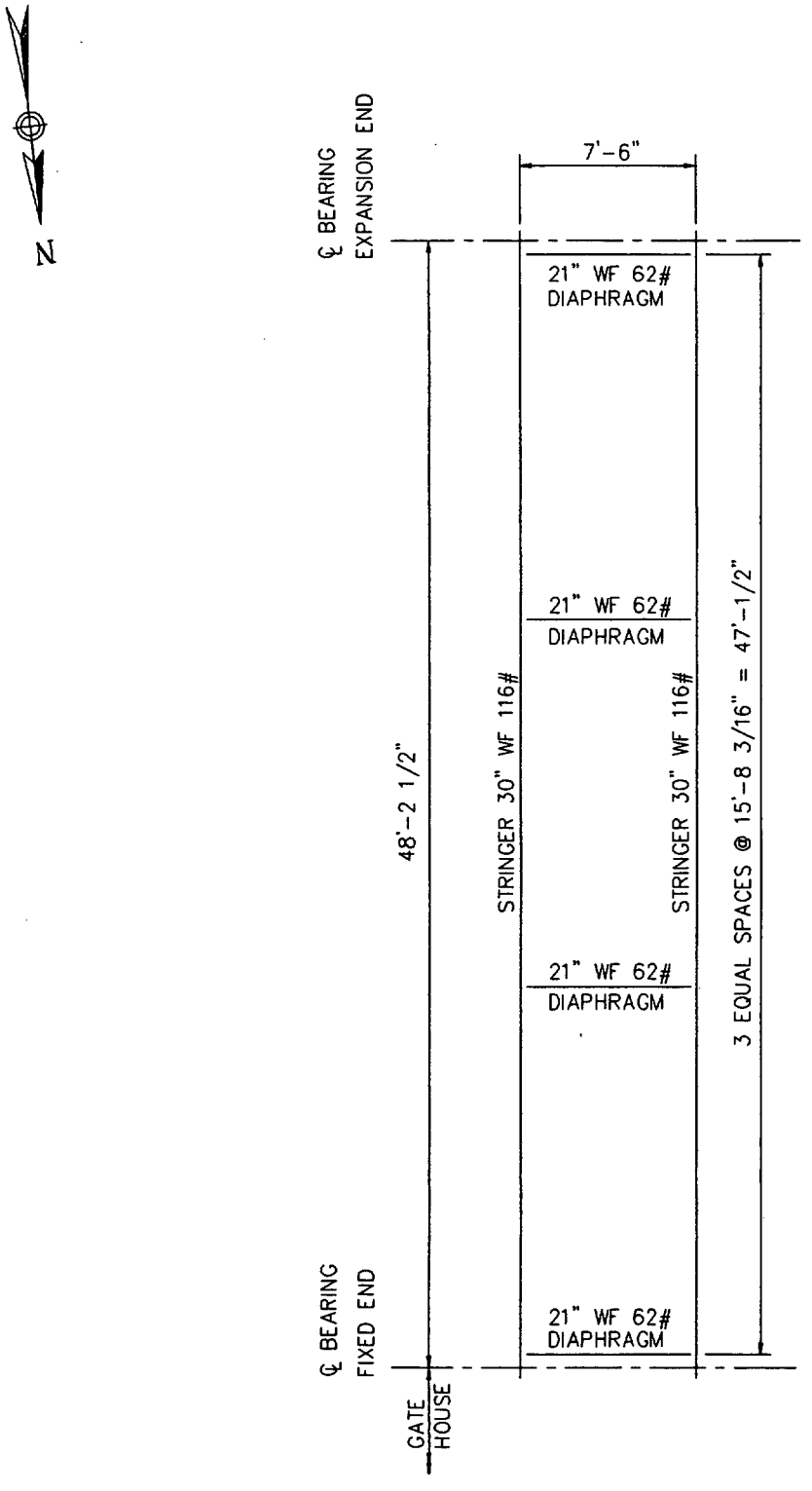
Service Bridge, Barre Falls Dam
Barre, Massachusetts

PROJECT LOCATION PLAN

Fig. 1



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Service Bridge, Barre Falls Dam
Barre, Massachusetts

FRAMING PLAN

SCALE 1/8" = 1'-0"

FIG. 2

US ARMY CORPS OF ENGINEERS
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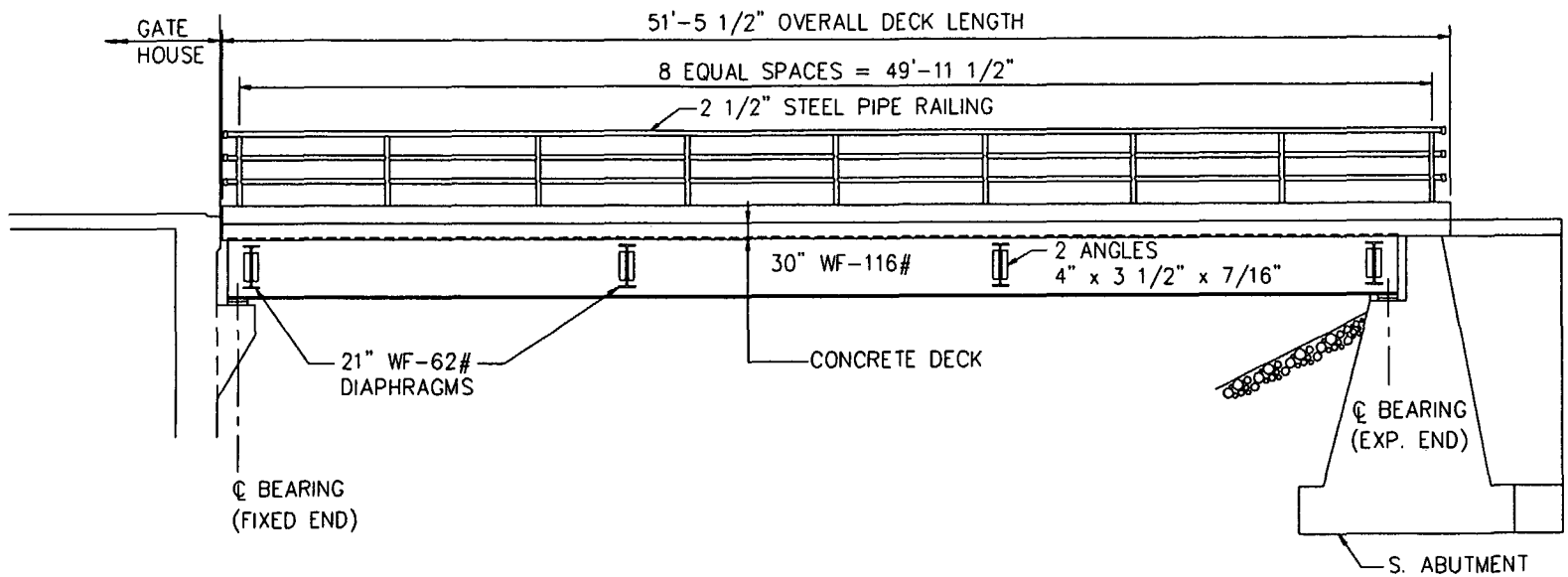
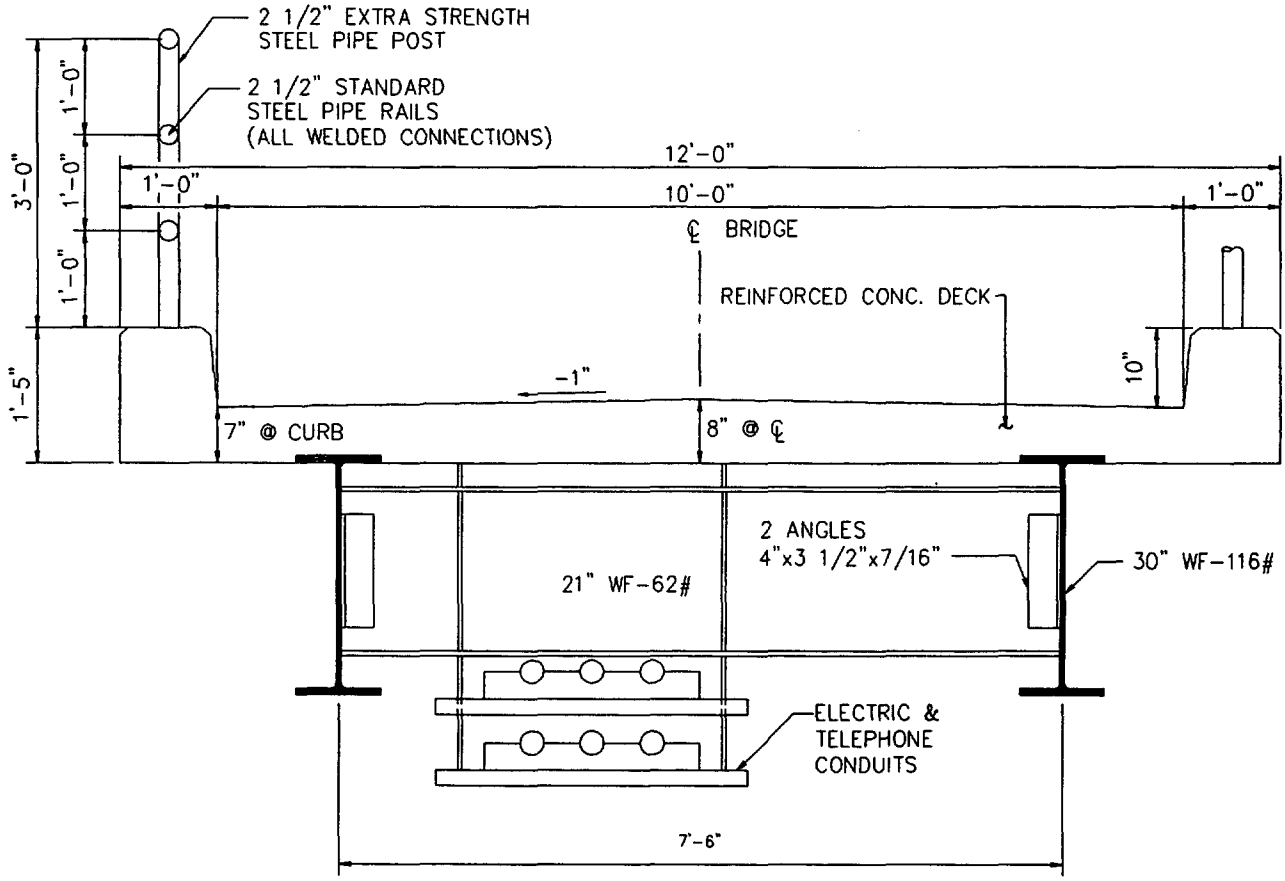
Service Bridge, Barre Falls Dam
Barre, Massachusetts



ELEVATION

SCALE 1/8" = 1'-0"

FIG. 3



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Service Bridge, Barre Falls Dam
Barre, Massachusetts

TYPICAL CROSS SECTION

SCALE 1/2" = 1'-0"

FIG. 4

US ARMY CORPS OF ENGINEERS
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Service Bridge, Barre Falls Dam
Barre, Massachusetts

SUMMARY OF INSPECTION

NOT TO SCALE

FIG. 5

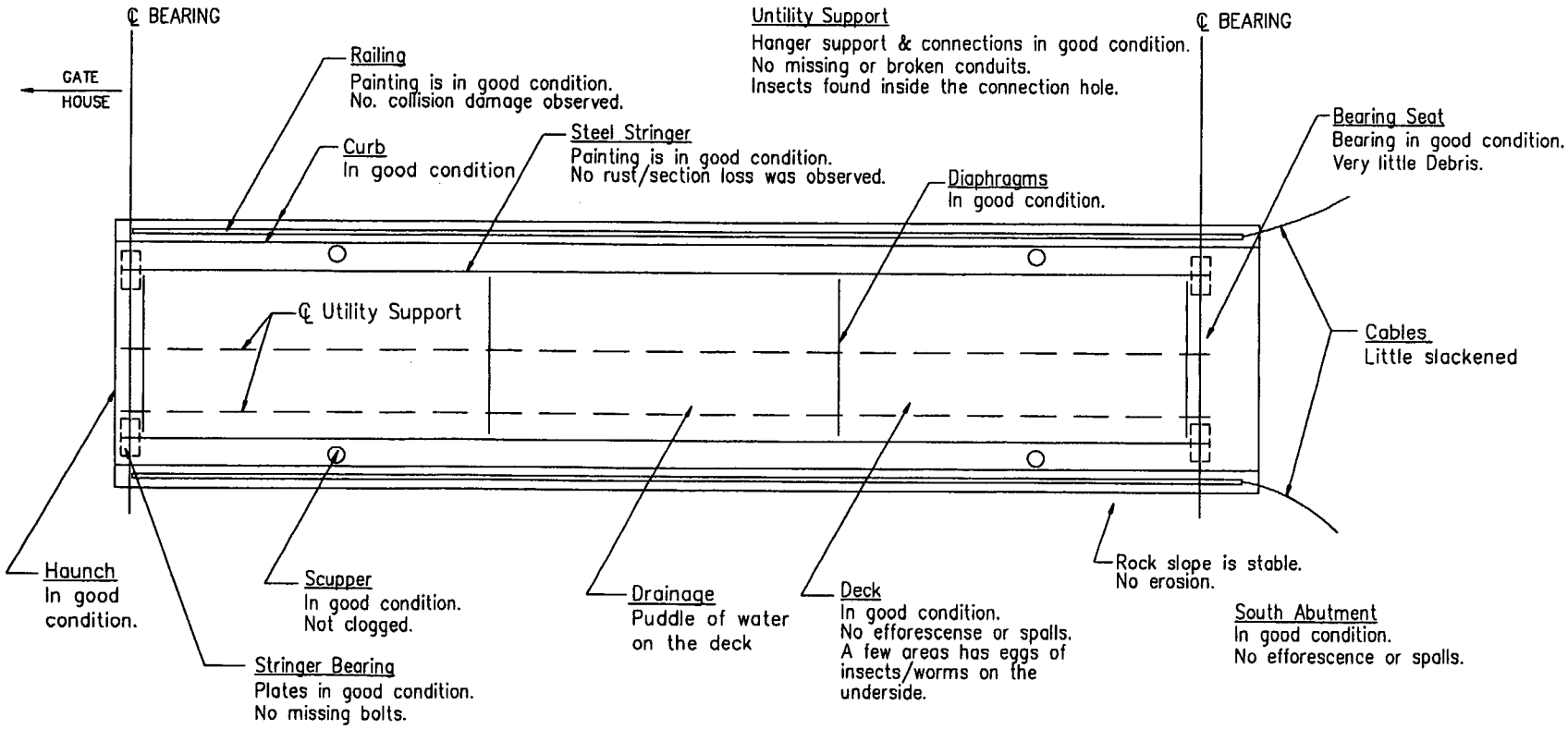
STEEL STRINGER 30" WF 116#

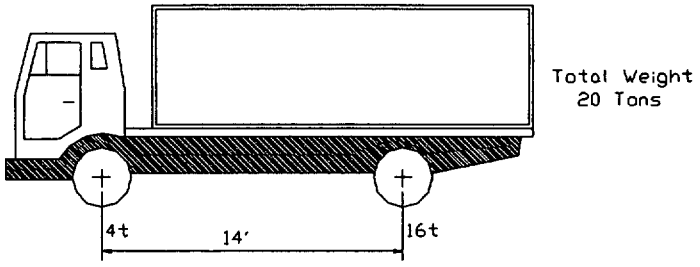
In good condition

N

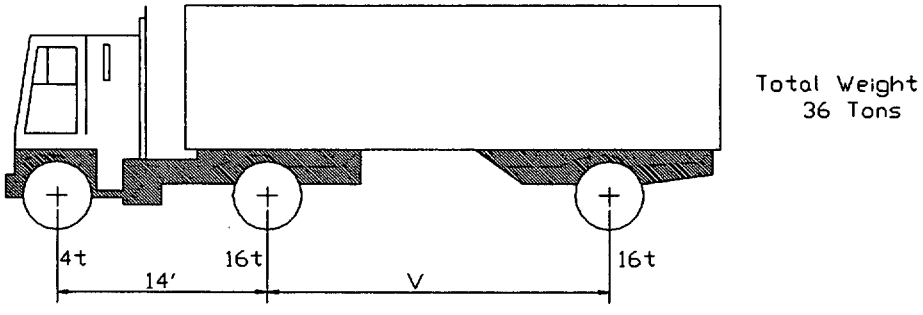
FRACTURE CRITICAL MEMBER

SCALE: 1/2" = 1'-0"





H-20



V = Variable spacing - 14 feet to 30 feet inclusive. Spacing to be used is that which produces maximum stresses.

Type HS20-44

Appendix A

PHOTOS

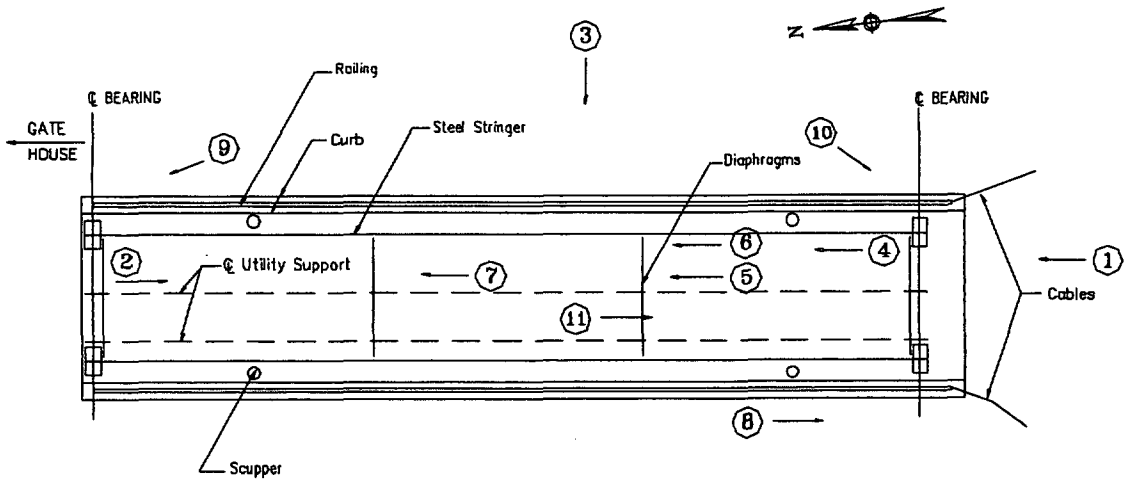


PHOTO LOCATION PLAN

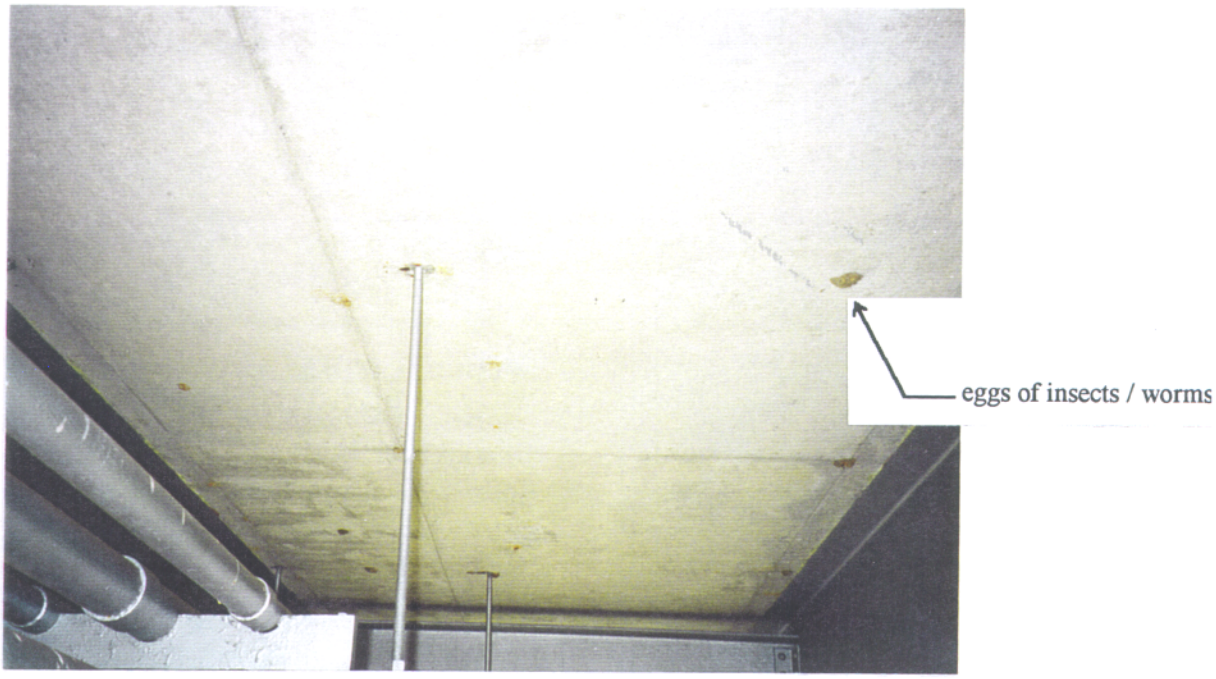
Photo No.	Description
1.	South Approach
2.	Bridge Deck Surface (Looking South)
3.	East Elevation
4.	East Railing & Curb
5.	Underside Of Deck
6.	Typical diaphragm to Stringer Connection
7.	Utility Support
8.	Southwest Bearing
9.	Gate House
10.	South Abutment / Wingwall
11.	Utility Support

1. South Approach

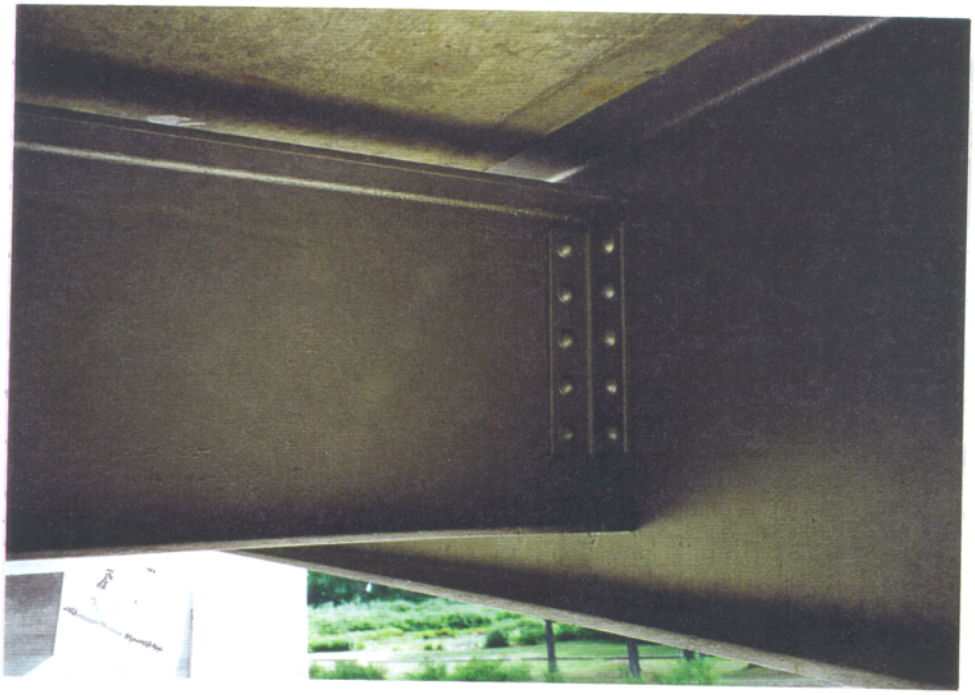
2. Bridge Deck Surface (Looking South)

3. East Elevation

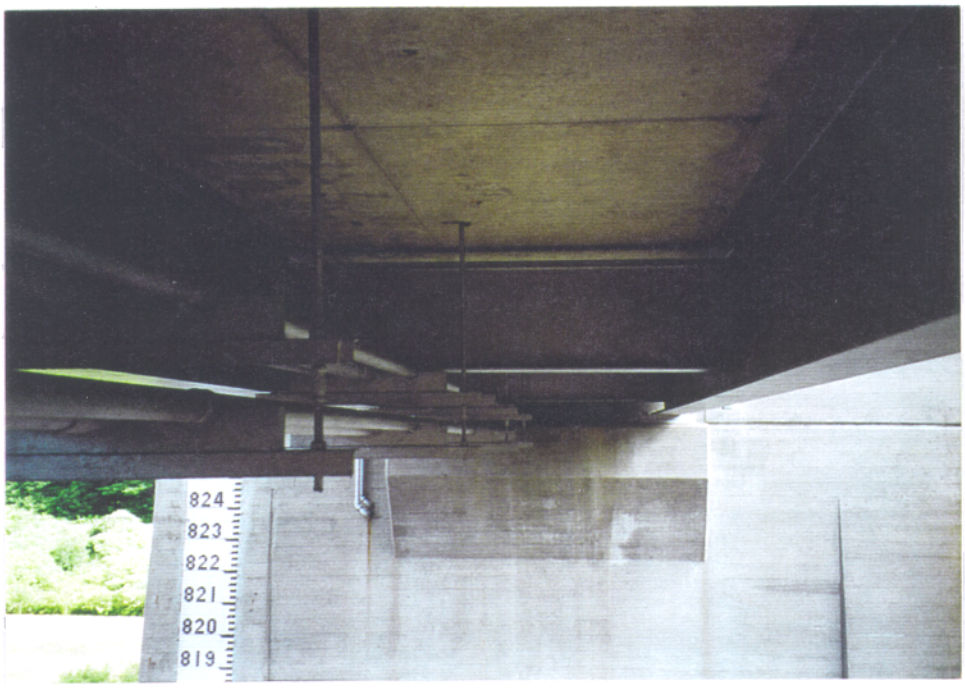
4. East Railing & Curb



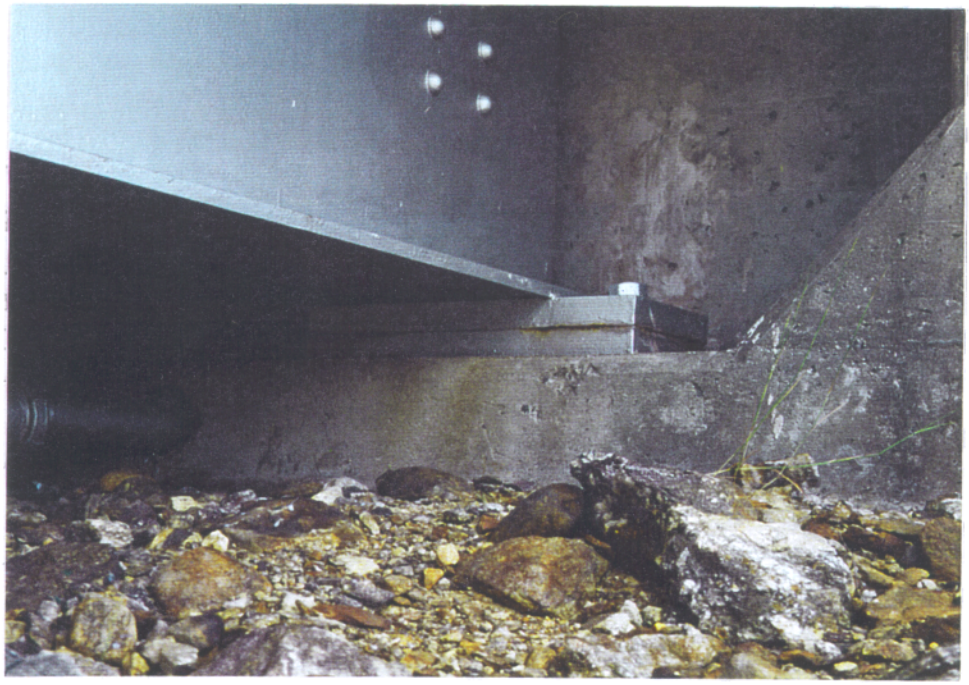
5. Underside Of Deck



6. Typical Diaphragm to Stringer Connection



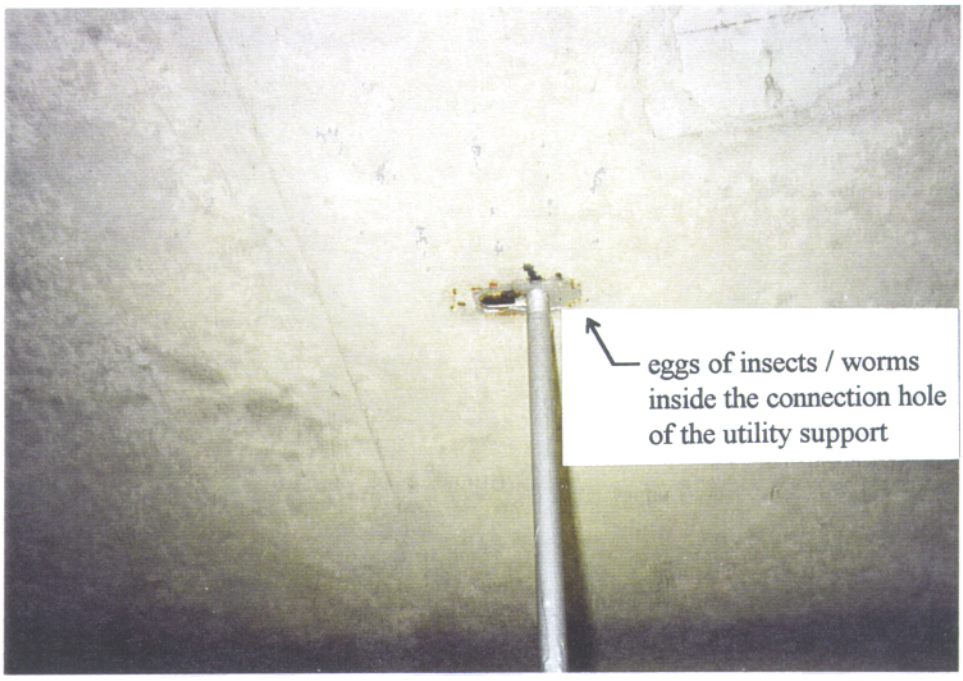
7. Utility Support



8. Southwest Bearing

9. Gate House

10. South Abutment / Wingwall



11. Utility Support

Appendix B

BRIDGE INSPECTION FORM

- Structures Inspection Field Report
- Structure Inventory and Appraisal Form

MASSACHUSETTS HIGHWAY DEPARTMENT

STRUCTURES INSPECTION FIELD REPORT

ROUTINE INSPECTION

city/town	bridge dept. no.	8-structure no.	90-date inspected
Barre, Massachusetts	NA	Barre Falls Dam Service Bridge	7/19/95

2-dist.	104-highway system	22-owner	27-year built	106-year rebuilt	11-milepoint
NA	NA	COE	1958	NA	NA

43-structure type: Steel Stringer (1-span)	quality control engineer: K.C. Lam, P.E.
07-facility carried: Access Road to Gate House	team leader: K.C. Lam, P.E.
06-features intersected: Access Road to Spillway	team members: C.D. Ye, W.C. Pien

item 58	7
DECK	
1. Wearing Surface	7
2. Deck - Condition	7
3. Stay in Place Forms	NA
4. Curbs	7
5. Median	NA
6. Sidewalks	NA
7. Parapet	NA
8. Railing	7
9. Anti Missile Fence	NA
10. Drains	7
11. Lighting Standards	NA
12. Utilities	7
13. Deck Joints	7
14. Approach Settlement	7

item 59	7
SUPERSTRUCTURE	
1. Bearing Devices	7
2. Stringers	7
3. Diaphragms	7
4. Girders or Beams	NA
5. Floor Beams	NA
6. Trusses	NA
7. Rivets or Bolts	7
8. Welds	7
9. Collision Damage	8
10. Load Deflection	7
11. Member Alignment	7
12. Load Vibration	7
13. Paint - Epoxy	7
14. Year Painted	
15. Under Clearance ___ ft NA in	
Clearance Signs ☐ yes ☒ no	

item 60	7
SUBSTRUCTURE	
1. Abutments	
a-Wings	7
b-Backwall	7
c- Bridge Seats	7
d-Brestwall	7
e-Footings	NA
f-Piles	NA
g-Erosion	7
h-Settlement	7
2. Piers or Bents	
a-Caps	NA
b-Column	NA
c-Web	NA
d-Footing	NA
e-Piles	NA
f-Scour	NA
g-Settlement	NA
3. Collision Damage	8
4. Adequacy - Hydraulically	NA

Actual Posting	H	3	3S2	HS20	Single
	☐	☐	☐	☐	☐
Recommended Posting From Rating Book	☐	☐	☐	☐	☐

SIGNS IN PLACE Y or N	at bridge	advance
	N	N
LEGIBILITY	☐	☐

Overhead Signs (attached to bridge) ☐ yes ☒ no

1. Welds	☐
2. Bolts	☐
3. Condition	☐

Item93b U/W Inspection Date: _____

ITEM 61-channel and channel protection: NA

1. channel scour	☐	5. rip rap or slope paving	☐
2. embankment erosion	☐	6. effectiveness	☐
3. fender system	☐	7. debris	☐
4. spur dikes & jetties	☐	8. vegetation	☐

36-Traffic Safety features

	36	condition
1. bridge railing	1	7
2. transitions	NA	NA
3. approach guardrail	NA	NA
4. guardrail terminal	NA	NA

X=UNKNOWN NA=NOT APPLICABLE IA=INACCESSIBLE

Remarks, Photos and Sketches.

city/town	bridge dept. no.	8-structure no.	90-date inspected
Barre, Massachusetts	NA	Barre Falls Dam Service Bridge	7/19/1995

ACCESSABILITY

Y/N	LIFT BUCKET	BOAT	RAILROAD FLAGMAN	INSPECTOR 50	OTHER	RIGGING	STAGING	TRAFFIC CONTROL	UNDERWATER INSPECTION	HOURS
Y				Y						

CURB REVEAL: 10"

PLANS? Y/N: Y

SCOUR: Y/N N

RE-RATE?

Y/N	PRIORITY
N	

RATING REPORT

Y/N	DATE
Y	9/1995

IDENTIFICATION

(1) STATE NAME - MASSACHUSETTS CODE 251
(200) COE DIVISION OFFICE SYMBOL CE NEW ENGLAND
(201) COE DISTRICT OFFICE SYMBOL CE NEW YORK
(202) COE BRIDGE NUMBER - CE
(8) STATE STRUCTURE NUMBER # NA
(5) STATE INVENTORY ROUTE (ON/UNDER) NA
- (a), (b), . . . , (e)
(2) STATE HIGHWAY DEPARTMENT DISTRICT - CODE 3
(2) COUNTY CODE (4) PLACE CODE
(6) FEATURES INTERSECTED - SERVICE ROAD TO SPILLWAY
(7) FACILITY CARRIED - SERVICE ROAD TO GATE HOUSE
(9) LOCATION - BARRE FALLS DAM SERVICE BRIDGE
(11) MILEPOINT NA -
(16) LATITUDE ° ' - LONGITUDE ° ' -
(98) BORDER BRIDGE STATE CODE - % SHARE - %
(99) BORDER BRIDGE STRUCTURE NO. # NA

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: MATERIAL - STEEL
TYPE - STRINGER CODE 302
(44) STRUCTURE TYPE APPR: MATERIAL - NA
TYPE - CODE
(45) NUMBER OF SPANS IN MAIN UNIT 1
(46) NUMBER OF APPROACH SPANS 0
(107) DECK STRUCTURE TYPE - REINF. CONC. CODE
(108) WEARING SURFACE / PROTECTIVE SYSTEM: NA
A) TYPE OF WEARING SURFACE - CODE
A) TYPE OF MEMBRANE - CODE
A) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1958
(106) YEAR CONSTRUCTED 1958
(42) TYPE OF SERVICE ON SERVICE BRIDGE
UNDER UPSTREAM OF DAM CODE 10
(28) LANES: ON STRUCTURE 1 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC MINIMAL
(30) YEAR OF ADT 19 (109) TRUCK ADT %
(19) BYPASS, DETOUR LENGTH NA MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 48 FT
(49) STRUCTURE LENGTH 51 FT
(50) CURB / SIDEWALK: LEFT 0 - 0 FT / RIGHT 0 - 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 10 - 0 FT
(52) DECK WIDTH OUT TO OUT 12 - 0 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) - 0.0 FT
(33) BRIDGE MEDIAN - NONE CODE 0
(34) SKEW 00 DEG (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 99 FT 99 IN
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 10 - 0 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 99 FT 99 IN
(54) MIN VERT UNDERCLEAR REF - 0 FT 0 IN
(55) MIN LAT UNDERCLEAR RT REF - 99.9 FT
(56) MIN LAT UNDERCLEAR LT 0.0 FT

(App C) SUFFICIENCY RATING -
STATUS

NOTE: ITEM NUMBERS CORRESPOND WITH THOSE USED IN THE FHWA NATIONAL BRIDGE INVENTORY EXCEPT FOR THOSE GREATER THAN 199, WHICH ARE UNIQUE TO THE USACE.

NAVIGATION DATA NA

(38) NAVIGATION CONTROL - CODE 0
(111) PIER PROTECTION - CODE 0
(39) NAVIGATION VERTICAL CLEARANCE 000 FT
(116) VERT - LIFT BRIDGE NAV MIN VERT CLEAR 0 FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0000 FT

CLASSIFICATION

(112) NBIS BRIDGE LENGTH 48'-2 1/2" CODE
(104) HIGHWAY SYSTEM N/A CODE
(26) FUNCTIONAL CLASS - SERVICE BRIDGE CODE 06
(100) DEFENSE HIGHWAY - NO CODE
(101) PARALLEL STRUCTURE - NO CODE
(102) DIRECTION OF TRAFFIC - 2-WAY CODE
(103) TEMPORARY STRUCTURE - NO CODE
(110) DESIGNATED NATIONAL NETWORK -
(20) TOLL - NO CODE
(21) MAINTENANCE RESPONSIBILITY USACE CODE
(22) OWNER - USACE
(37) HISTORICAL SIGNIFICANCE NO CODE

CONDITION CODE

(58) DECK 7
(59) SUPERSTRUCTURE 7
(60) SUBSTRUCTURE 7
(61) CHANNEL & CHANNEL PROTECTION NA
(62) CULVERTS NA

CONDITION CODE

(31) DESIGN LOAD - H12 1
(64) OPERATING RATING -
(66) INVENTORY RATING -
(70) BRIDGE POSTING - NONE
(41) STRUCTURE OPEN, POSTED OR CLOSED -
DESCRIPTION -

APPRAISAL CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 5
(69) UNDERCLEARANCES, VERTICAL & HORIZONTAL N
(71) WATERWAY ADEQUACY N
(72) APPROACH ROADWAY ALIGNMENT 5
(36) TRAFFIC SAFETY FEATURES 5
(113) SCOUR CRITICAL BRIDGES N

PROPOSED IMPROVEMENT

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT FT
(94) BRIDGE IMPROVEMENT COST $, , 000
(95) ROADWAY IMPROVEMENT COST $, , 000
(96) TOTAL PROJECT COST $, , 000
(97) YEAR OF IMPROVEMENT COST ESTIMATE 19/20
(114) FUTURE ADT
(115) YEAR OF FUTURE ADT 19/20

INSPECTIONS

(90) INSPECTION DATE 8/95 (91) FREQUENCY MO
(92) CRITICAL FEATURE INSPECTION: (93) CFI DATE
A) FRACTURE CRIT DETAIL - - MO A) /
B) UNDERWATER INSP - - MO B) /
C) OTHER SPECIAL INSP - - MO B) /
( ) INSPECTED BY: (203) & (204)
(205) INSPECTION COST - $

Appendix C

COMPUTATIONS

Page

LAMSON ENGINEERING CORPORATION		Final Page No. C2
Project BARRE FALLS DAM - SERVICE BR	Job No. 9510	Preliminary Sheet No.
Subject RATING	Preparer COY	Date 7/95
Detail SUMMARY	Checker	Date

RATING SUMMARY

LOADING	COMPONENT	INVENTORY (TONS)		OPERATING (TONS)	
		MOMENT	SHEAR	MOMENT	SHEAR
HS20-44 (36T)	DECK SLAB	29.1	—	38.9	—
	STRINGERS	26.2	190.8	46.3	269.3
H20-44 (20T)	DECK SLAB	16.1	—	21.7	—
	STRINGERS	20.3	148.6	35.8	209.6

LAMSON ENGINEERING CORPORATION		Final Page No. C3
Project BARRE FALLS DAM - SERVICE BR	Job No. 9510	Preliminary Sheet No.
Subject RATING	Preparer CDY	Date 7/95
Detail	Checker	Date

REFFERENCES:

1) AASHTO STANDARD SPECIFICATIONS, 15TH EDITION 1992 & CURRENT INTERIMS

2) MANUAL FOR CONDITION EVALUATION OF BRIDGES 1994

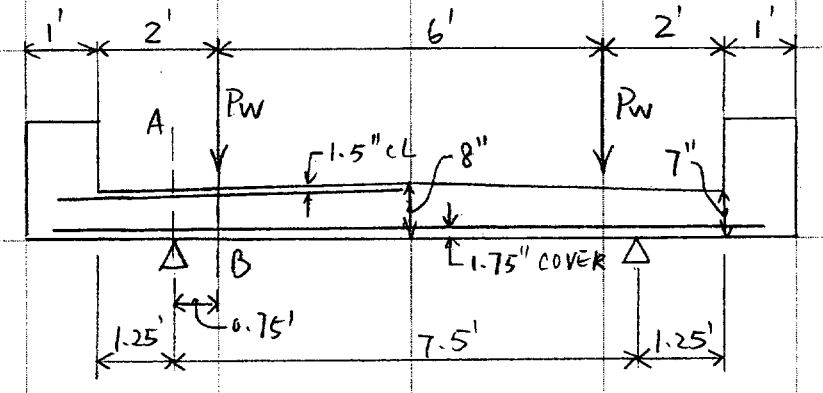
METHOD: ALLOWABLE STRESS METHOD

THE BRIDGE WAS BUILT IN 1956, AND IS IN GOOD CONDITION, NO SECTION LOSS.

SIMPLE SPAN. $\ell = 48' - 2\frac{1}{2}" = 48.21'$

* PER COE COMMENTS, CALCULATION IS REVISED WITHOUT CONSIDERING IMPACT.

LAMSON ENGINEERING CORPORATION		Final Page No. C4
Project BARRE FALLS DAM- SERVICE BR	Job No. 9510	Preliminary Sheet No. D1
Subject RATING / HS20	Preparer CDY	Date 7/95
Detail DECK SLAB	Checker	Date



STANDARD LOADING PATTERN FOR ONE 10' LANE

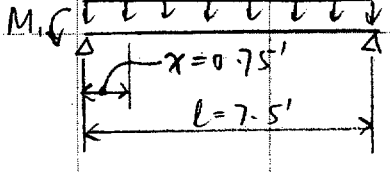
DEAD LOAD MOMENT

1) CANTILEVER SLAB. (AT SECTION A)

$$M_{DL} = D = 0.238^{KLF} \times (1+1.25'-0.5') + \left(\frac{7+7.25}{2} \times 1.25 \times 0.15/12\right) \times \frac{1.25'}{2}$$

$$M_{DL} = D = \underline{0.486}\ ^{1-K}/_{1}$$

2) BETWEEN STRINGERS (AT 0.75' FROM SUPPORT - SECTION B)



$M_1 = M_2 = 0.486\ ^{1-K}/_{1}$

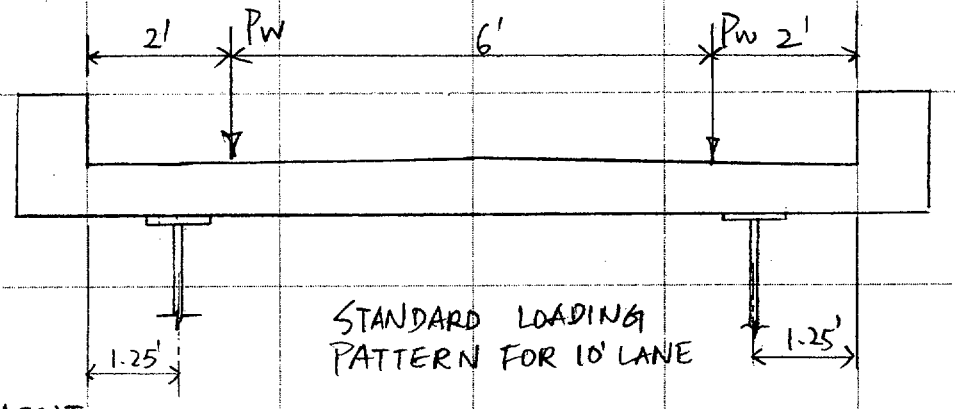
$$w = \frac{7.25+8}{2} \times 0.15 \times \frac{1}{12} = 0.095\ KLF$$

$x = 0.75'$

$$M_x = \frac{wx}{2}(l-x) + \frac{M_1 - M_2}{2} x - M_1$$

$$M_x = \underline{-0.246}\ ^{1-K}/_{1} = D$$

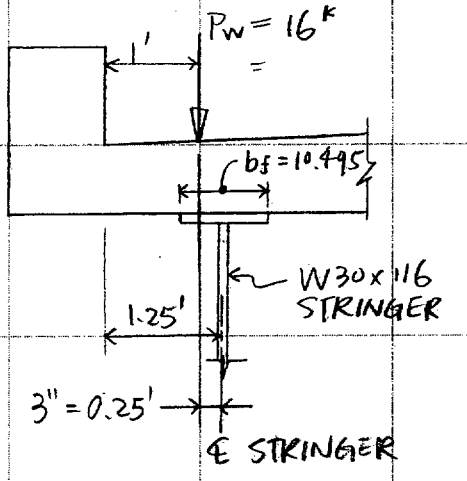
LAMSON ENGINEERING CORPORATION		Final Page No. C5
Project BARRE FALLS DAM - SERVICE BR.	Job No. 9510	Preliminary Sheet No.
Subject RATING / HS20	Preparer CDY	Date 7/95
Detail DECK SLAB	Checker	Date



STANDARD LOADING PATTERN FOR 10' LANE

LIVE LOAD MOMENT

1) PLACE Pw @ 1' FROM FACE OF CURB (AASHTO 3.24.2.1)



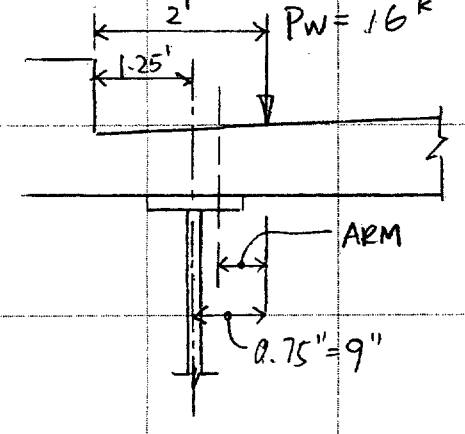
$$\text{ARM} = 3" - \tfrac{1}{4}\text{ FLANGE WIDTH}$$
$$= 3" - \tfrac{1}{4} \times 10.495"$$
$$= 0.376"$$
$$= 0.031'$$

$E = 0.8X + 3.75$ (AASHTO 3.24.2.1 CASE A)

$E = 0.8 \times 0.031' + 3.75' = 3.77'$

$L_I = \frac{16^k}{3.77'} \times 0.031' = \underline{0.13\ ^{1-k}/_{1}}$ (CANTILEVER SLAB)

2) STANDARD LOADING PATTERN



$$\text{ARM} = 9" - \tfrac{1}{4}\text{ FLANGE WIDTH}$$
$$= 9" - \tfrac{1}{4} \times 10.495"$$
$$= 6.376"$$
$$= 0.53'$$

USE $E = 3.77'$ From CANTILEVER SLAB.

$L_I = \frac{16^k}{3.77'} \times 0.53' = \underline{2.25\ ^{1-k}/_{1}}$ (SLAB BET. STRINGERS)

LAMSON ENGINEERING CORPORATION		Final Page No. C6
Project BARRE FALLS DAM - SERVICE BR.	Job No. 9510	Preliminary Sheet No. D2
Subject RATING / HS20	Preparer CDY	Date 7/95
Detail DECK SLAB	Checker	Date

THE MAIN REINFORCEMENT IS # 4 @ 12" TOP & BOT. OF SLAB.

INVENTORY RATING

FOR CANTILEVER SLABS:

$d = 7.25" - 1.5" - 0.25" = 5.5"$, $A_s = 0.2\ ^{IN^2}$, $n = 12$

$f_c' = 2500$ PSI, $f_c = 1000$ PSI — INVENTORY

$f_c = 1500$ PSI — OPERATING

$f_s = 20$ KSI (INVENTORY)

$f_s = 28$ KSI (OPERATING)

$$k = \frac{1}{1 + f_s/n f_c} = \frac{1}{1 + 20/(12 \times 1)} = 0.375$$

$j = 1 - k/3 = 1 - 0.375/3 = 0.875$; $jd = 0.875 \times 5.5 = 4.81"$

$M = A_s f_s jd = 0.2 \times 20 \times 4.81/12 = 1.60^{1-K} = C$

$$RF = \frac{C - D}{L_I} = \frac{1.60 - 0.486}{0.13} = 8.57$$

$RT = (8.57)(36^{TONS}) = \underline{308.5 \text{ TONS}}$

SLAB BET. STRINGERS:

@ 0.75' FROM STRINGER:

$d = 7.4" - 1.75" - 0.25" = 5.4"$. $A_s = 0.2\ ^{IN^2}$. $jd = 4.73"$

$M = 0.2 \times 20 \times 4.73/12 = 1.57^{1-K} = C$

$$RF = \frac{C - D}{L_I} = \frac{1.57 - (-0.246)}{2.25} = 0.807$$

$RT = (0.807)(36^{TONS}) = \underline{29.1 \text{ TONS}}$

LAMSON ENGINEERING CORPORATION		Final Page No. C7
Project BARRE FALLS DAM - SERVICE BR	Job No. 9510	Preliminary Sheet No. D3
Subject RATING / HS20	Preparer CDY	Date 7/95
Detail DECK SLAB	Checker	Date

OPERATING RATING

CANTILEVER SLAB:

$$k = \frac{1}{1 + 28/(12 \times 1.5)} = 0.391$$

$$j = 1 - \frac{0.391}{3} = 0.870 \qquad jd = 0.870 \times 5.5'' = 4.785''$$

$$M = A_s f_s j d = 0.2 \times 28 \times 4.785 / 12 = 2.23^{1-K} = C$$

$$RF = \frac{C - D}{L_I} = \frac{2.23 - 0.486}{0.13} = 13.42$$

$$RT = (RF)W = 13.42 \times 36^{TONS} = \underline{483\ TONS}$$

SLAB BETWEEN STRINGERS:

$$M = A_s f_s j d = 0.2 \times 28 \times 0.87 \times 5.4 = 26.31^{11-K} = 2.19^{+K} = C$$

$$RF = \frac{C - D}{L_I} = \frac{2.19 - (-0.246)}{2.25} = 1.08$$

$$RT = 1.08 \times 36^{TONS} = \underline{38.9\ TONS}$$

DECKSLAB RATING SUMMARY - HS20 LOADING *

	INVENTORY	OPERATING
CANTILEVER SLAB	308.5 TONS	483 TONS
**SLAB BET. STRINGERS	29.1 TONS	38.9 TONS

* SINCE THE RATING RESULTS ARE LESS THAN 36 TONS. RATING FOR H-20 TRUCK LOADING WILL BE PERFORMED.

** CONTROLS, USE AS THE RESULTS OF DECK SLAB RATING FOR HS20-44 LOADING.

LAMSON ENGINEERING CORPORATION		Final Page No. C9
Project BARRE FALLS DAM - SERVICE BR.	Job No. 9510	Preliminary Sheet No. S1
Subject RATING / HS20	Preparer CDY	Date 7/95
Detail STRINGER	Checker	Date

DEAD LOAD

DECK SLAB: $12' \times (7.5"/12) \times 0.15^{KCF} = 1.125^{KLF}$

CONC. COPING: $(17"-7.5")/12 \times 1' \times 0.15^{KCF} \times 2^{EA} = 0.238^{KLF}$

RAILING: $5.79^{PLF} \times 3^{EA} \times 2^{SIDES}/1000 = 0.035^{KLF}$

RAIL POST: $7.66^{PLF} \times 3^{EA} \times 2^{SIDES}/6.24/1000 = 0.007^{KLF}$

STRINGER (W30x116): $116^{PLF} \times 2^{EA}/1000 = 0.232^{KLF}$

DIAPHRAGM (W21x62): $62^{PLF} \times 2^{EA} \times 7.5'/48.21'/1000 = 0.019^{KLF}$

$\Sigma = 1.656^{KLF}$

DEAD LOAD ON EACH STRINGER: $1.656^{KLF}/2 = 0.828^{KLF}/STRINGER$

ELECTRIC & TELEPHONE CONDUITS:

15 PLF SUPPORT $= 0.015^{KLF}$

15 PLF/CONDUIT $\times 6^{EA} = 0.09^{KLF}$

$\Sigma = 0.105^{KLF}$

DISTRIBUTE INTO ONE STRINGER: $0.105 \times \frac{5'}{7.5'} = 0.07^{KLF}$

TOTAL DEAD LOAD PER STRINGER: $0.828 + 0.07 \approx \underline{0.90^{KLF}}/STRINGER$

$M_{DL} = \frac{0.90^{KLF} \times (48.21')^2}{8} = \underline{261.5}^{1-K}/STRINGER = D$

LIVE LOAD

HS20: $595.9^{1-K}/2 = 298.0^{1-K}/STRINGER$

↑ APPENDIX A W/ $\ell = 48.21$

L.L. DISTRIBUTION: $DF = \frac{S}{7} = \frac{7.5}{7} = 1.071$

$\therefore M_{LL} = 298.0^{1-K} \times 1.071 = \underline{319.2}^{1-K}/STRINGER = L$

LAMSON ENGINEERING CORPORATION		Final Page No. C9
Project BARRE FALLS DAM - SERVICE BR	Job No. 9510	Preliminary Sheet No. S2
Subject RATING / HS20	Preparer EDY	Date 7/95
Detail STEEL STRINGER - MOMENT	Checker	Date

ALLOWABLE STRESS

REF. 2, TABLE 6.6.2.1-1 & 6.6.2.1-2:
BRIDGE BUILT BET. 1936 & 1963 : $F_Y = 33{,}000$ PSI

TOP FLANGE (IN COMPRESSION) SUPPORTED LATERALLY IN FULL LENGTH BY EMBEDMENT IN CONCRETE :

$F_b = 18{,}000$ PSI (INVENTORY)

$F_b = 24{,}500$ PSI (OPERATING)

STRINGER CAPACITY

W30 x 116 : $I_x = 4930\ IN^4$, $S_x = 329\ IN^3$

$C = F_b \cdot S_x = 18^{KSI} \times 329^{IN^3} = 5922^{11-K} = 493.5^{1-K}$ (INVENTORY)

$C = F_b \times S_x = 24.5^{KSI} \times 329^{IN^3} = 8060.5^{11-K} = 671.7^{1-K}$ (OPERATING)

RATING

$$RF = \frac{C - A_1 D}{A_2 L (1+I)}, \quad RT = (RF)W \quad \text{(REF. 2, 6.5.1 ~ 6.5.2)}$$

$A_1 = A_2 = 1.0$ FOR ALLOWABLE STRESS METHOD

$D = 261.5^{1-K}$, $L = 319.2^{1-K}$ $I = 0$

INVENTORY: $$RT = \frac{493.5 - 261.5}{319.2} \times 36^{TONS} = 0.727 \times 36^{TONS} = \underline{\underline{26.2^{TONS}}}$$

OPERATING:

$$RT = \frac{671.7 - 261.5}{319.2} \times 36^{TONS} = 1.285 \times 36^{TONS} = \underline{\underline{46.3^{TONS}}}$$

LAMSON ENGINEERING CORPORATION		Final Page No. C10
Project BARRE FALLS DAM-SERVICE BR.	Job No. 9510	Preliminary Sheet No. S3
Subject RATING / HS 20	Preparer CDY	Date 7/95
Detail STEEL STRINGER – SHEAR	Checker	Date

SHEAR DUE TO DEAD LOAD

$V_{DL} = 0.90^{KLF} \times 48.21'/2 = \underline{21.69^{K}}$ / STRINGER = D

SHEAR DUE TO LIVE LOAD

$V_{LL} = 58.1^{K} \times 1.071 / 2 = \underline{31.11^{K}}$ / STRINGER = L

↑ AASHTO APPENDIX A

ALLOWABLE STRESS

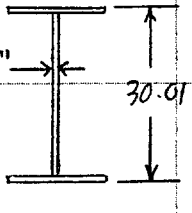
REF. 2 – TABLE 6.6.2.1-1 & 6.6.2.1-2

$F_v = 11{,}000$ PSI – INVENTORY

$F_v = 15{,}000$ PSI – OPERATING

CAPACITY

W 30 x 116



$A = 0.565'' \times 30.01'' = 16.96^{\square''}$

$C = F_v A = 11^{KSI} \times 16.96^{\square''} = 186.6^{K}$ (INVENTORY)

$C = F_v A = 15^{KSI} \times 16.96^{\square''} = 254.4^{K}$ (OPERATING)

RATING

$RF = \frac{C - D}{L(HI)}$, $RT = (RF)W$, $I = 0$

INVENTORY:

$RT = \frac{186.6 - 21.69}{31.11} \times 36^{TONS} = 5.30 \times 36^{TONS} = \underline{190.8^{TONS}}$

OPERATING:

$RT = \frac{254.4 - 21.69}{31.11} \times 36^{TONS} = 7.48 \times 36^{TONS} = \underline{269.3^{TONS}}$

LAMSON ENGINEERING CORPORATION		Final Page No. C11
Project BARRE FALLS DAM - SERVICE BR.	Job No. 9510	Preliminary Sheet No. D4
Subject RATING / H20	Preparer CDY	Date 7/95
Detail DECK SLAB	Checker	Date

DEAD LOAD MOMENT

CANTILEVER SLAB: $M_{DL}=D = 0.486$ ft-k/ft

SLAB BET. STRINGERS: $M_{DL}=D = -0.246$ ft-k/ft

L.L. MOMENT

$P_W = 16^k$, $E = 3.77'$

CANTILEVER SLAB: $L_I = 0.13$ ft-k/ft

SLAB BET. STRINGERS: $L_I = 2.25$ ft-k/ft

	INVENTORY	OPERATING
CANTILEVER SLAB	$\left(\frac{C-D}{L_I}\right)W = \frac{1.60-0.486}{0.13} \times 20^{TONS} = 171^{TONS}$	$\frac{2.23-0.486}{0.13} \times 20^{TONS} = 268$ TONS
*SLAB BET. STRINGERS	$\left(\frac{C-D}{L_I}\right)W = \frac{1.57-(-.246)}{2.25} \times 20^{TONS} = 16.1^{TONS}$	$\frac{2.19-(-.246)}{2.25} \times 20^{TONS} = 21.7$ TONS

* CONTROLS, USE AS RESULTS OF DECK SLAB RATING FOR H20-44 LOADING.

LAMSON ENGINEERING CORPORATION		Final Page No. C13
Project BARRE FALLS DAM – SERVICE BR	Job No. 9510	Preliminary Sheet No.
Subject RATING	Preparer	Date
Detail	Checker	Date

2nd Calculation

LAMSON ENGINEERING CORPORATION		Final Page No. C14
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. 1 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail SUMMARY	Checker	Date

RATING SUMMARY - HS 20-44 LOADING (36 TONS)

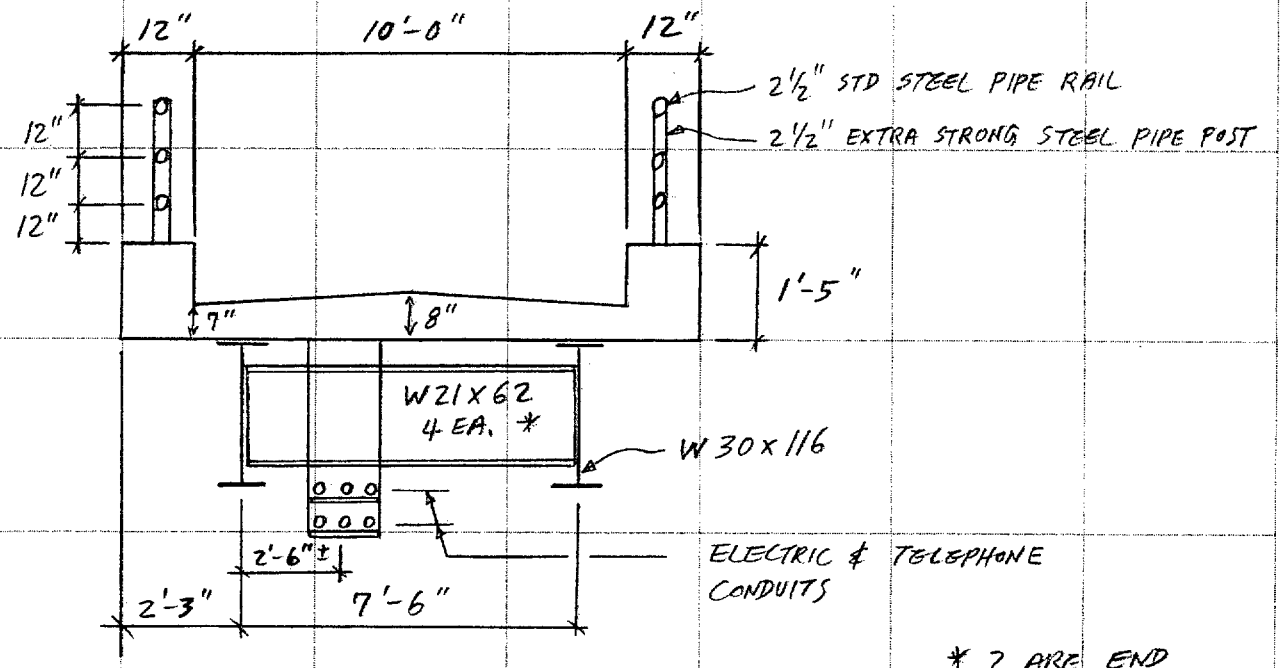
WORKING STRESS DESIGN METHOD

COMPONENT		INVENTORY (TONS)	OPERATING (TONS)
STEEL STRINGER	- MOMENT	27.1	47.2
	- SHEAR	190.7	269.2
DECK SLAB	- MOMENT	29.0	38.9

RATING SUMMARY - H20-44 LOADING (20 TONS)

COMPONENT		INVENTORY (TONS)	OPERATING (TONS)
STEEL STRINGER	- MOMENT	21.0	36.5
	- SHEAR	148.5	209.6
DECK SLAB	- MOMENT	16.1	21.6

LAMSON ENGINEERING CORPORATION		Final Page No. C 15
Project BARRE FALLS DAM – SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. S1 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail STEEL STRINGER	Checker	Date



SECTION (NOT TO SCALE)

* 2 ARE END DIAPHRAGMS

SIMPLE SPAN, $\ell = 48' - 2\frac{1}{2}" = 48.21'$

BRIDGE BUILT ABOUT 1956 – EXCELLENT CONDITION – NO SECTION LOSSES

LIVE LOAD FOR RATING IS HS 20-44 (36 TONS TRUCK)

NUMBER OF DESIGN LANE IS ONE

RATING BASE ON WORKING STRESS DESIGN METHOD

FROM APPENDIX A OF AASHTO STD. SPEC. FOR HIGHWAY BRIDGES –

@ $\ell = 50'$, $M_{LL} = 627.9^{1-K}$/LANE

@ $\ell = 48'$, $M_{LL} = 592.1^{1-K}$/LANE

@ $\ell = 48.21'$, $M_{LL} \cong 595.9^{1-K}$/LANE

L.L. DIST. INTO STRINGERS IS $S/7.0 \Rightarrow DF = \frac{7.5'}{7.0} = 1.071$

LAMSON ENGINEERING CORPORATION		Final Page No. C16
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. S2 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail STEEL STRINGER	Checker	Date

LIVE LOAD MOMENT PER STRINGER - WITHOUT IMPACT

$M_{LL} = (595.9^{1-K})(.5)(1.071) = \underline{319.10^{1-K}/\text{STRINGER}} = L$

DETERMINE DEAD LOAD OF SUPERSTRUCTURE -

CONC. DECK $= \left(\frac{7.5''}{12}\right)(10')(.15^{KCF}) = 0.94^{KLF}$

CONC. COPING $= (1.42')(1')(.15^{KCF})(2) = 0.426^{KLF}$

STRINGER = W30x116 x 2EA $= 0.232^{KLF}$

DIAPHRAGMS $= (2)(.062^{KLF})(7.5')/47.46' = 0.02^{KLF}$

RAILING $= (5.79^{PLF})(3)(2\text{ SIDES})/1000 = 0.035^{KLF}$

RAIL POST $= (7.66^{PLF})(3')(2\text{ SIDES})\left(\frac{1}{6.24'}\right)/1000 = 0.007^{KLF}$

$\Sigma = 1.66^{KLF}$

DISTRIBUTES INTO 2 STRINGERS $\Rightarrow W_{DL} = 0.83^{KLF}/\text{STRINGER}$.

ELECTRIC & TELEPHONE CONDUITS -

ESTIMATE WT @ APPROX. 15 PLF PER CONDUIT

$W_{UTIL.} = (6)(0.015^{KLF}) = 0.09^{KLF}$

ADD 15^{PLF} $^{\pm}$ FOR HANGER SUPPORT

$W_{UTIL.} = 0.09 + 0.015 = 0.105^{KLF}$

DISTRIBUTES INTO ONE STRINGER -

$W_{UTIL.} = (0.105^{KLF})\left(\frac{5'}{7.5'}\right) = 0.07^{KLF}$

$\therefore \quad W_{DL} = 0.83^{KLF} + 0.07^{KLF} = \underline{0.90^{KLF}/\text{STRINGER}}$

$M_{DL} = \frac{(0.90^{KLF})(47.46')^2}{8} = \underline{253.4^{1-K}/\text{STRINGER}} = D$

LAMSON ENGINEERING CORPORATION		Final Page No. C17
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. S3 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail STEEL STRINGER	Checker	Date

LIVE LOAD IMPACT, $I - \phi$

FROM TABLE 6.6.2.1-1 OF THE 1994 AASHTO MANUAL FOR CONDITION EVALUATION OF BRIDGES —

$F_Y = 33^{KSI}$ FOR STEELS BUILT BETWEEN 1936 TO 1963

$I_{W30\times116} = 4,930^{IN^4}$; $S_x = 329^{IN^3}$

TOP FLANGE IS CONTINUOUSLY SUPPORTED BY THE CONC. DECK SLAB.

$F_b = 18^{KSI}$, INVENTORY RATING

CAPACITY OF MEMBER, $C = (329^{IN^3})(18^{KSI}) = 5,922^{11-K}$

$= \underline{493.5^{1-K}}$

$RF = \dfrac{C - A_1 D}{A_2 L (1+I)}$; $A_1 = A_2 = 1.0$ FOR WORKING STRESS DESIGN

$= \dfrac{493.5^{1-K} - 253.4^{1-K}}{(319.10^{1-K})(1+0)} = 0.752$

$RT = (RF)(W)$

$= (0.752)(36^{TON}) = \underline{27.1^{TONS}}$ INVENTORY RATING

$F_b = 24.5^{KSI}$ FROM TABLE 6.6.2.1-2, OPERATING RATING

$C = (329^{IN^3})(24.5^{KSI}) = 8,060.5^{11-K} = \underline{671.7^{1-K}}$

$RF = \dfrac{671.7^{1-K} - 253.4^{1-K}}{(319.10^{1-K})(1+0)} = 1.311$

LAMSON ENGINEERING CORPORATION		Final Page No. C18
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. S4 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail STEEL STRINGER	Checker	Date

$RT = (1.311)(36^{TONS}) = \underline{47.2^{TONS}}$ / OPERATING RATING

STEEL STRINGER RATING — MOMENT

	INVENTORY	OPERATING
HS20-44	27.1^{TONS}	47.2^{TONS}

MAX LIVE LOAD SHEAR — FROM APPENDIX A TABLE

@ $\ell = 50'$, $V_{LL} = 58.5^K$/LANE

@ $\ell = 48'$, $V_{LL} = 58.0^K$/LANE

@ $\ell = 48.21'$, $V_{LL} = \underline{58.1^K/LANE}$ /

LIVE LOAD SHEAR PER STRINGER — WITHOUT IMPACT

$V_{LL} = (58.1^K)(.5)(1.071) = \underline{31.11^K/STRINGER}$ / $= L$

SHEAR DUE TO DEAD LOAD

$V_{DL} = (0.90^{KLF})(48.21')/2 = \underline{21.69^K/STRINGER}$ / $= D$

ALLOWABLE SHEAR STRESS, $F_V = 11^{KSI}$ FOR INVENTORY

$F_V = 15^{KSI}$ FOR OPERATING

STRINGER SHEAR CAPACITY, $C = (30.01")(0.565")(11^{KSI}) = \underline{186.5^K/INV.}$ /

$RF = \dfrac{186.5^K - 21.69^K}{(31.11^K)(1.0)} = 5.30$; $RT = (5.30)(36^{TONS}) = \underline{190.7^{TONS}}$ /

INVENTORY RATING

LAMSON ENGINEERING CORPORATION		Final Page No. C19
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. 55 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail STEEL STRINGER	Checker	Date

STRINGER SHEAR CAPACITY, $C = (30.01")(0.565")(15^{KSI}) = 254.33^{K}$ / OPER.

$RF = \dfrac{254.33^{K} - 21.69^{K}}{(31.1^{K})(1.0)} = 7.48$; $RT = (7.48)(36^{TONS}) = 269.2^{TONS}$ / OPERATING RATING

STEEL STRINGER RATING - SHEAR

	INVENTORY	OPERATING
HS 20-44	190.7 TONS	269.2 TONS

RATING FOR H-20 LOADING

$M_{LL} = 427.7^{1-K} \times 1.07 \,1/2 = 229.0^{1-K} = L$ — MOMENT

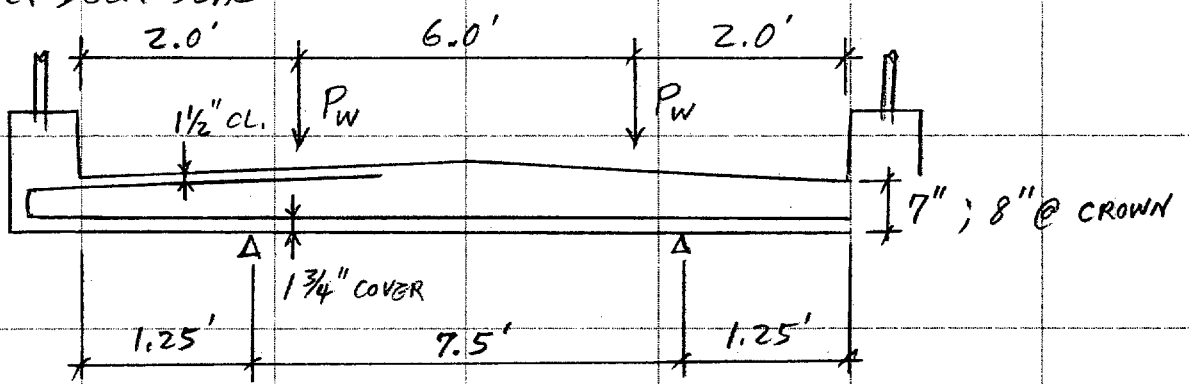
APPENDIX A OF AASHTO

$V_{LL} = 41.5^{K} \times 1.07 \,1/2 = 22.2^{1-K} = L$ — SHEAR

	INVENTORY	OPERATING
MOMENT	$\left(\frac{493.5 - 253.4}{229.0 \times 1.0}\right) \times 20^{TONS} = 21.0^{TONS}$	$\left(\frac{671.7 - 253.4}{229.0 \times 1.0}\right) \times 20^{TONS} = 36.5^{TONS}$
SHEAR	$\left(\frac{186.5 - 21.69}{22.2 \times 1.0}\right) \times 20^{TONS} = 148.5^{TONS}$	$\left(\frac{254.3 - 21.69}{22.2 \times 1.0}\right) \times 20^{TONS} = 209.6^{TONS}$

LAMSON ENGINEERING CORPORATION		Final Page No. C 20
Project BARRE FALLS DAM – SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. C 1 B
Subject RATING	Preparer D. CGG	Date 7/95
Detail DECK SLAB	Checker	Date

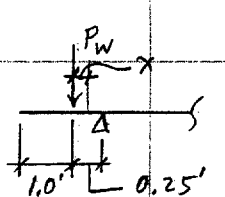
CONC. DECK SLAB –



CROSS SECTION WITH STANDARD LOADING PATTERN FOR ONE 10' LANE.

ARTICLE 3.24.2.1 REQUIRED PLACING WHEEL LOAD, P_W, AT ONE FOOT FROM THE FACE OF CURB.

$P_W = (16^K)(1.0) = 16.0^K$, NO IMPACT



CANTILEVER DECK

ARTICLE 3.24.5.1.1, EQ. (3-17)

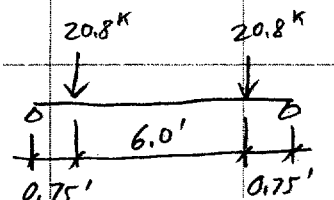
$E = 0.8X + 3.75$; WHERE $X = 0.25' - \frac{1}{4}$ FLANGE WIDTH $= 0.03'$

$E = (0.8)(.03') + 3.75 = 3.77'$

$M^-_{LL+I} = \left(\frac{16.0^K}{3.77'}\right)(.03') = 0.127^{'-K}/_{'}$ *

* SMALL. THE POSITIVE MOMENT CONTROLS. WILL NOT CONTINUE FOR THIS CASE.

CHECK MAX POSITIVE MOMENT –



MOMENT ARM $= 0.75' - \frac{1}{4} \times 10.495 \times \frac{1}{12} = 0.53'$

$M^+_{LL+I} = (16.0^K)(.53') \div 3.77'$

$= 2.25^{'-K}/_{'}$ POSITIVE MOMENT IN SLAB BET. STRINGERS $= L_I$

AASHTO DOES NOT HAVE A WHEEL DISTRIBUTION FOR THIS PARTICULAR LOADING CONDITION. CONSERVATIVELY USE E FOR CANTILEVER SLAB. THIS DISTRIBUTION IS SAME AS THAT FOR RAIL POST.

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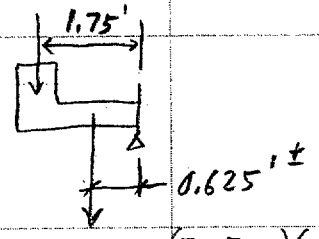
Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. C2 B
Subject RATING	Preparer D. CEE	Date 7/95
Detail DECK SLAB	Checker	Date

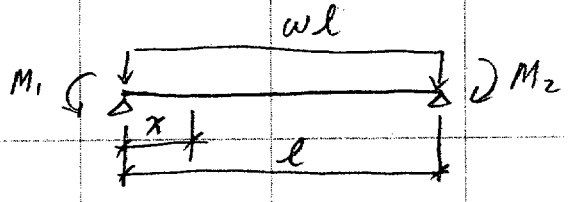
DETERMINING DEAD LOAD MOMENT IN DECK SLAB —

$P_1 = 0.213^K + 0.021^K = 0.234^{KLF}$



$P_2 = \left(\frac{7+7.25}{2}\right)(1.25)(.15)/12 = 0.111^{KLF}$

$M^-_{DL} = (0.234)(1.75) + (0.111)(0.625) = \underline{0.48^{1-K}/1} = D$



WHERE $M_1 = M_2 = 0.48^{1-K}/1$

$w = \left(\frac{7.25+8}{2}\right) \div 12 \times .15 = 0.095^{KLF}$

$l = 7.5' \times 12 = 90''$

$x = 0.75' \times 12 = 9''$

$M_x = \frac{wx}{2}(l-x) + \frac{(M_1 - M_2)}{l}(x) - M_1$ (the $\frac{(M_1 - M_2)}{l}$ term $= 0$)

$M_x = \frac{(0.095^{KLF})(9'')}{(2)(12)}(90''-9'') - (0.48^{1-K})(12) = -2.874^{''-K}$

$= \underline{-0.24^{1-K}/1} = D$

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Project BARRE FALLS DAM - SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. C3 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail DECK SLAB	Checker	Date

BASED ON AVAILABLE INFORMATION, THE MAIN TRANSVERSE REINFORCEMENT APPEARS TO BE #4 @ 12" AT POSITIVE AND NEGATIVE MOMENT REGIONS.

M^+ CAPACITY BET. STRINGER

$d = 7.4" - 1.75" - 0.25" = 5.4"$; $A_s = 0.2^{\square"}$; $n = 12$

$f_c' = 2,500$ PSI ; $f_c = 1000$ PSI, INVENTORY ; $f_c = 1500$ PSI OPERATING

$f_s = 20^{KSI}$ INVENTORY

$f_s = 28^{KSI}$ OPERATING

INVENTORY RATING —

$$k = \frac{1}{1 + f_s/n f_c} = \frac{1}{1 + 20^{KSI}/(12)(1^{KSI})} = 0.375$$

$$j = 1 - \tfrac{1}{3} k = 1 - \tfrac{1}{3}(0.375) = 0.875$$

$$a = \frac{f_s}{12000} \times j = \frac{20\,000^{PSI}}{12000} \times 0.875 = 1.458$$

$$M = A_s\, a\, d = (0.2^{\square"})(1.458)(5.4") = 1.57^{'-K}$$

OR $j d = (0.875)(5.4") = 4.725"$

$$M = T j d = (0.2^{\square"})(20^{KSI})(4.725") = 18.9^{"-K} = 1.57^{'-K}$$ ∴ OK.

$C = 1.57^{'-K} / 1.$ / INVENTORY

$$RF = \frac{C - D}{L_I} = \frac{1.57^{'-K} - (-0.24)^{'-K}}{2.25^{'-K}} = 0.804$$

$RT = (0.804)(36^{TONS}) = 29.0^{TONS}$ / INVENTORY RATING BET. STRINGER

LAMSON ENGINEERING CORPORATION		Final Page No. C23
Project BARRE FALLS DAM – SERVICE BRIDGE	Job No. 9510	Preliminary Sheet No. C4 B
Subject RATING	Preparer D. LEE	Date 7/95
Detail DECK SLAB	Checker	Date

OPERATING RATING —

$$k = \frac{1}{1 + \frac{28\ ksi}{(12)(1.5\ ksi)}} = 0.391 \quad ; \quad j = 1 - \frac{0.391}{3} = 0.870$$

$jd = (0.870)(5.4") = 4.698"$ @ M^+ REGION

$M = (0.20")(28\ ksi)(4.698") = 26.31^{"-k} = 2.19^{'-k}$

$C = 2.19^{'-k} / 1$ OPERATING

$$RF = \frac{2.19^{'-k} - (-0.24)^{'-k}}{2.25^{'-k}} = 1.08 \quad ; \quad RT = (1.08)(36\ TONS) = 38.9\ TONS$$

OPERATING RATING BET. STRINGER

SINCE RATING RESULTS ARE LESS THAN 36 TONS, RATING FOR H20-44 LOADING IS NECESSARY.

Appendix D

AVAILABLE PLAN

The attahced plan was made available to Lamson Engineering Corp. in determining the Live Load Capacity Rating of the bridge.

Conneticut River Flood Control
Barre Falls Dam
Service Bridge
Plan and Sections
Ware River, Massachusetts
Date: Feb. 1956
Drawing No. CT-1-3114 (1sheet)

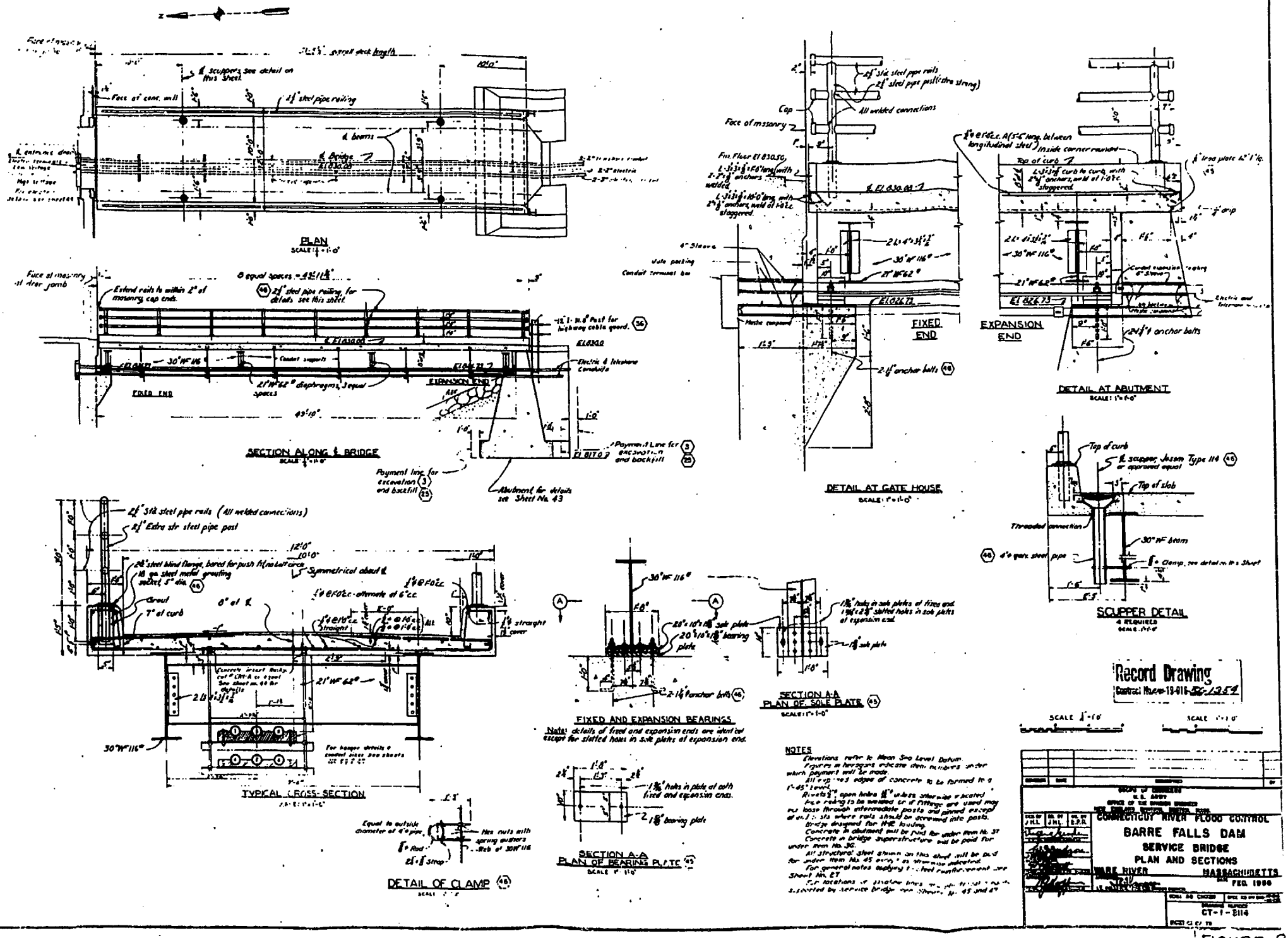
PLAN
SECTION ALONG ℄ BRIDGE
DETAIL AT GATE HOUSE
FIXED END
EXPANSION END
DETAIL AT ABUTMENT
SCUPPER DETAIL
4 REQUIRED
TYPICAL CROSS-SECTION
FIXED AND EXPANSION BEARINGS
SECTION A-A
PLAN OF SOLE PLATE
SECTION A-A
PLAN OF BEARING PLATE
DETAIL OF CLAMP
Record Drawing
NOTES
Elevations refer to Mean Sea Level Datum
All exposed edges of concrete to be formed to a 1"-45° bevel.
Concrete in abutment will be paid for under Item No. 37
Concrete in bridge superstructure will be paid for under Item No. 39.
All structural steel shown on this sheet will be paid for under Item No. 45 except as otherwise indicated.
For general notes applying to steel reinforcement see Sheet No. 27
CONNECTICUT RIVER FLOOD CONTROL
BARRE FALLS DAM
SERVICE BRIDGE
PLAN AND SECTIONS
BARRE RIVER MASSACHUSETTS
FEB. 1960
CT-1-B114

FIGURE 2